EXG-0659
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PROGRESS REPORT

Period of December 1 to December 31, 1963

Contract No. AF33(600)40280

TABLE OF CONTESTS

A F-101 FLIGHT TEST

Film Evaluation

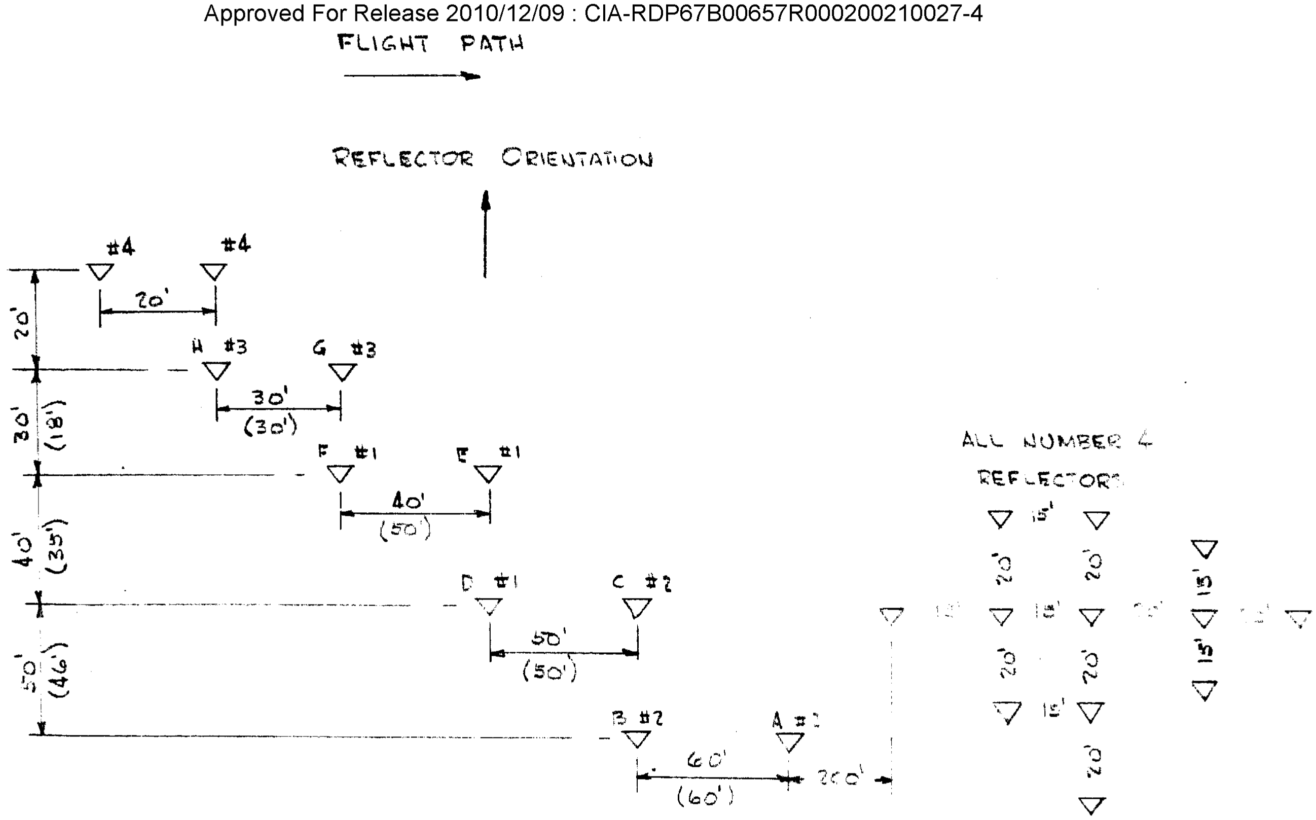
Satisfactory radar mapping was obtained on five of the six missions flown during December. Several correlations on the first flight of the month, flight 86, produced exceptional results. Typical correlated dot sizes and target separations are 5 to 7 mils (18 to 26 feet) in range and 3 to 5 mils (15 to 25 feet) in azimuth. Specific targets resolved are street patterns and buildings in Martinsburg, W. Va., and Frederick, Md., limestone quarries, single and multiple railroad lines, runways and taxi-ways at Martinsburg Airport, fruit orchards, and a corner reflector pattern.

Improved video uniformity in azimuth on these flights resulted from increasing the DFT output time constant with more stable antenna positioning.

Far range mapping is generally not as good as the near range. Alignment of the antenna pattern may not be correct for uniform signal return across the range sweep. Correlator set-up may not be focused as well on the far range.

Figure 1 shows the corner reflector layout and sizes. Dimensions between reflectors are the actual spacing, while the bracketed dimensions are the dimensions measured from the film of flight 87. The group of number 4 reflectors is recorded on the film, but individual reflectors are not resolved on the first correlations of this film.

Receiver attenuation was added during several flights. As much as 15 db added in the receiver path did not cause the DFT to unlock or a complete loss of video. Attenuation was much more noticeable



RADAR DIMENSION	
#1 REFLECTOR	7150 ft²
#2 REFLECTOR	3630 ft²
#3 REFLECTOR	345 ft²
#4 REFLECTOR	35 ft²

on far range than near range, verifying that antenna gain drops off rapidly at far range.

System

The following deliverable units were given in-flight tests this month:

Power Supply	SN 003
Video Amplifier	SN 003
Control Panel	SN 003
Recorder	SN 006

Two DFT modifications made in late November produced better lock-on and more stable antenna control. These modifications reduced the input to the DFT mixer and increased the output amplifier integration time.

A pulse forming network and a charging choke in the transmitter failed during ground test. Replacing these units increased average output power by 3 db with an increase in pulse width to 30 nano-sec.

A leak in the antenna laminate caused a loss of pressure during Flight 91. Two antenna modules were replaced with spare modules.

Range resolution on Recorder 6 has approximately twice the line width in range of Recorder 5.

Instrumentation

A Flight Research Model III, 16 mm motion picture camera has been installed in the radar observer's cockpit. The camera boresight is 30° down from the horizontal to starboard, illuminating the same ground area as the antenna. A frame speed of 5 frames per second provides continuous coverage during a radar data run.

Spectra analysis of the video and gated video signal to the doppler frequency tracker from two flights indicates the doppler spectrum around the prf line has been reduced to a satisfactory level. This improvement was accomplished by reducing the input to the DFT mixer.

B PHASE II FLIGHT TEST

Antenna #2 and one set of the interconnecting waveguide was delivered to the customer. Final acceptance testing of the #3 Single Axis Platform and the Platform Electronics was performed at the suppliers plant and the two units delivered directly to the customer.

A preliminary fit check using profile templates of the radar and instrumentation in the vehicle compartment detected a few minor discrepancies. One interconnecting waveguide was two short; two pieces with correct dimensions are being made. The instrumentation frame and some boxes were modified to clear some unexpected protrusion of compartment equipment forward of the instrumentation. The tracker will be moved by vehicle personnel to prevent interference with the instrumentation recorder.

Some corrections are required on the support of the long interconnecting waveguide to allow joining its flange to the antenna input flange. The waveguide is also being checked on Antenna #3 at Westinghouse.

A slight modification is required on the outer cover of the Single Axis Platform to clear the connectors. Wires in the signal cable to the S. A. P. were reduced to #22 and all spares were eliminated to allow the cables to fit into the existing connectors.

When the S. A. P. is not installed, a special heat sink may be required to protect these connectors rated at 200°C. The flanges of the outer cover of the S. A. P. were removed to allow a proper fit on the heat sink in the final installation.

No major problems have been encountered on the antenna boresight procedure.

Fabrication and testing of the instrumentation and programmer are complete. Integration tests with the system remain. One mode was eliminated from the programmer modes of operation. Linear receiver operation, i.e. no limiting, was removed because of the distortion encountered in video amplifier in this abnormal mode.

C ENVIRONMENTAL TEST

A final pressure-temperature test was performed on #3 Antenna. Pressure leaks were observed at the joints of the radiating stick and the R. F. manifold, at the R.F. load screws in the sticks, and the repeated delamination of the ML fabric sealing the radiating sticks.

Technical reports on modified recorder #6 vibration and antenna temperature pattern evaluation were written.

The vibration fixture for the single axis platform electronics package was modified.

D RECORDER

Recorder #4 was optically realigned, cleaned up, and converted to handle thin base film at Itek.

Kaiser high voltage power supply #9889 passed the acceptance test satisfactorily and will be installed in Recorder #7. Another power supply, #9890, is ready for the acceptance tests.

Cathode ray tubes that will be delivered in the future will be longer and will require a different range of focus voltages. Changes must be made in the focus control to accommodate both the new and the old CRT's.

During December, both Recorders #5 and #6 were modified with the new delay circuitry for the high voltage power supply and the increase in focus control voltage range. A loop support bar was added to prevent the loop of thin base film from collapsing. The focus modulation circuit was reworked to improve focus over the full range.

Design Evaluation

Using a coherent 30 megacycle dot pattern locked to the scanning cycle, the resulting pattern on 8430 film with the fiber optic face plate CRT was resolved with excellent contrast over the full 4 1/8 inch scan with no noticeable fall-off. This signal represents a 500 cycle per inch capability. The pattern was still resolvable on film, but with reduced contrast, when the line scan was reduced one half, corresponding to 1000 cycles per inch.

Successful tests were performed on the loop sensor proportional control. A low torque potentiometer is fitted with an arm and feeler assembly designed so that the position of the film in the loop determines the setting of the potentiometer. This setting drives an amplifier which controls the speed of the loop control motors. No perceptible change in loop length were noted in a test over 200 feet of film. Further work is required to optimize the design.

Improvements were made in the focus modulation circuit to give equal amplitude on each cycle of the parabolic waveform. Observations through microscopes of a coherent 30 megacycles dot pattern locked to the scan cycle showed no defocusing along the trace within a plus or minus 5 volt swing of the focus voltage.

Two Wollensak field flatteners were received and are being mounted on Recorder #7 for tests during January.

E WESTINGHOUSE CATHODE RAY TUBE POWER SUPPLY

Tests were made on the high voltage power supply for changes in the ratio of the 15 KV and the 4 KV. The objective is to hold this ratio to 3.750 $\pm$ 0.004. The results of this test were that the ratio does not stay within this $\pm$ 0.004 tolerance. After one hour of operation the voltages were set for a ratio of 3.490. During the following three hours the ratio varied between 3.47876 and 3.49594.

The overheating of the supply and increase of input current during long periods of operation require further work.

F ANTENNA

Delamination of the fabric seal during environmental tests on Antenna #3 caused a laminate seal study to be initiated. The program consists of two phases, both underway..

First is an interim program to provide a back-up antenna for the Phase II Flight Test Program immediately. This consists of applying the adhesive over the complete fabric surface, rather than masking from the area of the slots in the waveguide. This should reduce the delamination with some sacrifice in antenna gain. If pressure-temperature and RF tests on one antenna module prove satisfactory, Antenna #3 will be stripped and modified in the same manner.

Concurrent with the interim program, a test program will be underway to establish the materials and processes for providing a good pressure seal without sacrificing R. F. performance. This will include:

(1) survey of the field for any new materials.

(2) R. F. testing of all samples for effect of gain, slot detuning, and azimuth radiation pattern.

(3) mechanical testing of samples passing the R. F. tests with life test with a heat-pressure and cold soak cycle, tensile test to determine force required to delaminate, and bond strength tests in a peel test machine.

(4) treatment at approximately 700°F and 2000 psi of samples of the ML fabric now used and tensile test to check the delamination. Results of this program would indicate the material to use in the ultimate modification of the antennas and spare modules.

G MOTION COMPENSATION

The motion compensation spec R1915 has been revised to be more specific concerning bearing stiction and feedback transducer characteristics and sent to the transducer supplier.

Stiction of the antenna bearings can cause errors in the antenna angular position with respect to a drift or pitch command. A maximum of .05 degrees of antenna position error is allowed. The first attempt at simulating a bearing at Westinghouse resulted in excessive friction and galling. A bearing processed in a manner similar to the final bearing is being procured for further tests here.

The actuator position feedback transducer does not meet spec in either linearity or scale factor. The actuator supplier promises that the final actuator will have a satisfactory transducer, now on hand. A duplicate of this transducer will be installed eventually in the actuator used here, which will serve as a spare on the Phase II flight test program.

Some preliminary antenna position versus angular command tests have been performed on the antenna servo without the antenna by coupling the actuator output piston to the feedback transducer instead of the antenna. Tracking has been rather erratic. Further investigation is required to determine the sources of the trouble.

Minneapolis-Honeywell continued modification of the first system, which will become the third and last system delivered in the present configuration.